

## Focus . . . Excess Head Injuries Among the Very Elderly

### *Introduction*

Head injuries are a major public health concern. Each year, Missouri residents experience 22,000 head injuries of varying degrees of severity. Roughly 1400 individuals per year are injured seriously enough to die, and over 4000 require inpatient hospitalization. In excess of 200 per year will suffer some degree of paralysis. A substantial number will have less obvious sequelae that impair their cognitive and social abilities. Fourteen percent of just the mild head-injured individuals are estimated to have difficulty holding a job<sup>1</sup>.

Head injuries are not distributed evenly in the population. Primarily because of their high rate of motor vehicle crashes, males are twice as likely as females to die or be hospitalized from a head injury. Minorities have slightly higher rates than whites, in large measure because of their much higher rates of being assaulted.

Head injury rates also vary substantially by age. According to the 1995-1997 Head and Spinal Cord Injury (HSCI) registry, the 55- to 64-year-olds had the lowest average annual rate at 68/100,000 population (Figure 1). With over 70 percent of their head injuries being due to motor vehicle crashes, the 15-24 year-olds had one of the highest rates at 169/100,000. This rate exceeds even that of some of the elderly; the 75- to 84-year-olds, who are much more likely to incur their head injuries from falls (5.5%), had a rate of 165/100,000. The highest head injury rate was found among the very elderly (age 85+). Their rate of 266/100,000 is three times higher than the rate for the youngest elderly, the 65-74 year-olds. It is 60 percent higher than the rate of 165 in their closest agemates, the 75- to 84-year-olds.

The very high head injury rate among the very elderly raises the question of whether they have higher rates of risk factors for head injuries or whether they have different risk factors for head injuries. On the surface, one would expect the eldest to have higher rates of most health problems. They do have higher rates of all types of injuries, according to mortality and hospital records. When combined into one file and unduplicated, these records show that the 85 and over group recorded 19,276 injuries in 1997, an overall injury rate of 1332/10,000. Those aged 75-84 had 12,632 injuries, a rate of 758. On the other hand, injury rates varied substantially by body region. The head injury rate for those age 85 and over was 121/10,000, whereas the chest injury rate was over 50 percent lower at 51/10,000. Thus, saying the elderly have higher rates of all problems does not explain their high rate of head injuries. The purpose of this study was therefore to identify factors that would begin to explain these high rates.

### *Method*

To compare the 75- to 84-year-olds with those 85 and over, the 1995-1997 HSCI registry of deaths and inpatient hospitalizations was first examined. Chi-square comparisons on all possible risk factors found that head injuries among the elderly and very elderly differed most on gender, scene of injury and cause of injury.

Eighty-five and over females had a rate of 232/100,000, 76 percent higher than the rate of 132/100,000 among 75- to 84-year-olds. Though the eldest males had the highest head injury rate (358/100,000), their rate was only 64 percent higher than that of their younger counterparts (218/100,000).

Roughly 50 percent of head injuries occurred at home for both groups of elderly. Because so many more of the 85 and over live in residential institutions, residential institutions recorded 29 percent of the head injuries among the 85 and over, but only 12 percent among the 75- to 84-year-olds. Per population in residential institutions, the head injury rate among the 85 and over was marginally higher than that for those aged 75-84 (207/100,000 vs. 185/100,000).

Falls are the leading cause of head injuries among the elderly. They occur at a higher rate for the very elderly, however. For those age 85 and over, falls accounted for 4 in 5 of the head injuries; among the 75-84 year-olds, falls accounted for 3 in 5 head injuries. These figures translate to rates that were twice as high for the very elderly (210/100,000 vs. 98/100,000). For all other causes, the rates were higher for the 75- to 84-year-olds than for the 85 and over. If the latter group had suffered the same rate of falls as the 75- to 84-year-olds, their head injury rate would have averaged 97/100,000, well below the younger group's rate of 165/100,000.

As the very elderly are more likely to be in residential institutions, they have more of their falls there. Thirty-five percent of those 85 and over had their falls in residential institutions, compared to 17 percent of the 75- to 84-year-olds. When calculated as rates per institutional population, the differences are not as dramatic. The 85 and over had a fall rate of 205/100,000, whereas the 75- to 84-year-olds had a rate of 176/100,000. Because the overall fall rate was so much higher among the very elderly (as indicated above), the biggest difference in fall rates must be for falls outside residential institutions. In fact, for those 85 and over, the rate was 150/100,000 noninstitutional population, over twice as high as the rate of 67/100,000 for the 75- to 85-year-olds.

Almost all of the head injuries occurring in residential institutions were due to falls—95 percent for the 75- to 84-year-olds and 99 percent for the 85 and over. Apparently, elderly residents have such restricted activities that they can only be injured by falling.

Inasmuch as falling appeared to underlie the high rate of head injuries among the very elderly, an effort was made to identify factors that increased the risk of falling. To include patients who were not hospitalized just for injuries, the file of hospital inpatients was used. All records from this file were used except those noting conditions that were late effects of injuries or diseases. The file was also unduplicated to eliminate readmission records. Because falls occurred in both the elderly group being studied, and to increase the reliability of the results, both groups were included in the study. This resulted in 12,455 records indicating a fall and 88,832 noting other injuries or diseases.

To uncover risk factors for falling, the diagnosis codes were used to create variables included in other studies of falls in the elderly.<sup>2,3,4,5</sup> These included dizziness, muscle problems, hypotension, gait disturbances, alcohol use, tranquilizer use, other drug use and osteoporosis. To identify any additional risk factors, fallers and nonfallers were compared on 13 broad variables corresponding to the body systems defined in the International Classification of Diseases Coding Manual (ICD-9-CM). These included diseases of the endocrine, circulatory, respiratory, digestive, genitourinary, nervous and musculoskeletal systems, infectious diseases, neoplasms, mental disorders, signs and symptoms, complications of surgical and medical care, and poisons<sup>6</sup>.

Along with age group and sex, these variables were analyzed by logistic regression. Like multiple regression, logistic regression attempts to estimate the importance of each variable while controlling for the influence of all other variables. Unlike multiple regression, it expresses the contribution of each variable in terms of an odds ratio. Thus, if patients with nervous system problems fall twice as often as those without such problems, the unique impact of nervous system problems would be expressed as an odds ratio of 2:1 (usually shortened to '2').

## Results

The analysis found that females and the very elderly (age 85+) were most likely to fall (Table 1). Patients with osteoporosis were almost three times as likely to fall as patients without osteoporosis. Gait problems and muscle problems were associated with nearly a two-fold increase in falls. Mental and nervous system disorders were also significantly related to falls, but to a much lesser degree (odds ratios barely larger than 1.0).

The 'Mental Disorders' and 'Nervous System' categories include a variety of health problems, so the 3-digit ICD-9 codes making up the categories were examined to see where fallers and nonfallers differed the most. Conditions that stood out were codes 290-Senile and Pre-Senile Organic Psychotic Conditions, 294-Other Organic Psychotic Conditions (including Alzheimer's-related dementia's, epilepsy and multiple sclerosis, among others), 298-Non Organic Psychoses (depressive psychoses, reactive confusion, etc.), 310-Specific Nonpsychotic Mental Disorders due to Organic Brain Damage (including such conditions as memory disturbances, senility and post-traumatic stress syndrome) and 311-Depressive Disorder. Similar factors turned up when the Nervous System category was examined at the 3-digit level. These included higher rates for 331-cerebral degeneration, 332-Parkinson's Disease, 369-blind and poor vision, and 389-hearing loss. With the exception of Parkinson's disease, Depressive Disorders, and gait and muscle problems, the 85-and-over patients had significantly higher rates on the above conditions and the risk factors in Table 1.

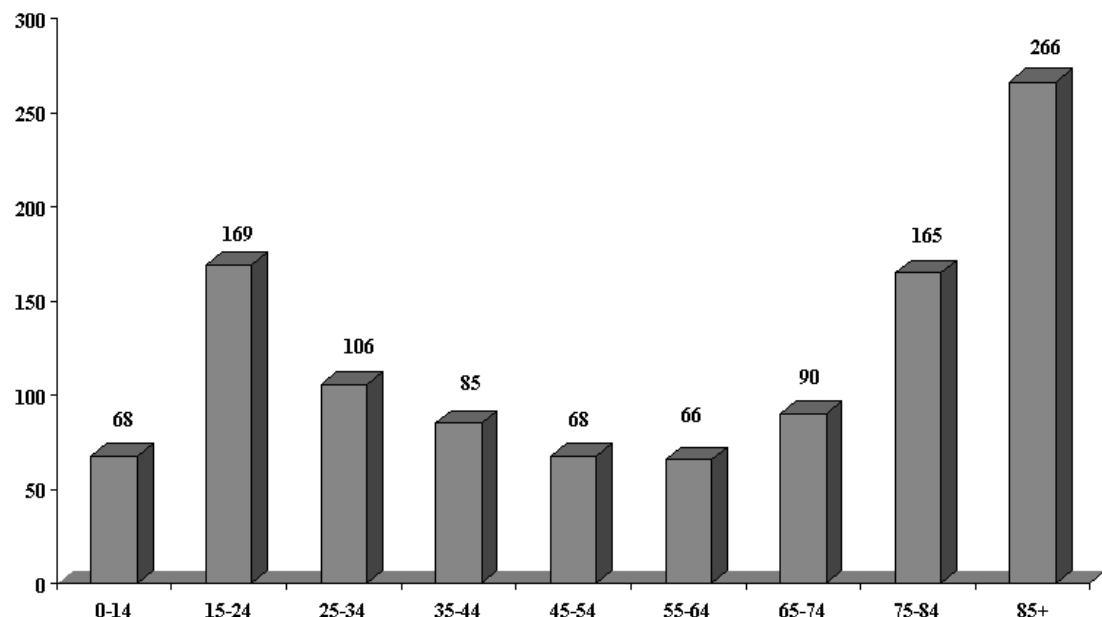
The results suggest that very elderly females are especially prone to fall from a variety of conditions and infirmities associated with aging. A number of the conditions, like osteoporosis and poor vision, aren't surprising as causes of falls in the very elderly. Hearing loss may signify damage to the part of the ear responsible for equilibrium, causing balance problems. Like the array of mental conditions, hearing loss may also contribute to falls through confusion and disorientation. All these factors, including the mental disorders, have been reported in other studies of falls among the elderly.

It should be kept in mind that logistic regression takes advantage of chance relationships, and the factors found to be related to falls in this study depended somewhat on which group was compared to those who fell. One analysis, which added 1996 inpatient records but restricted the patients to those 85 and over, found an odds ratio of 1.4 for complications of surgical and medical care, but did not produce a significant odds ratio for nervous system diseases. An analysis which included 75-84 year-olds but only records that noted an injury, produced all the factors in Table 1, but also found an odds ratio of 1.4 for alcohol-related diagnoses. Thus, it appears that the factors with the highest odds ratios were the most stable from one analysis to another. To better define the role of these factors in causing fall-related head injuries, as well as the influence of environmental factors, other studies are needed.

## References

- 1 Binder LM. A Review of Mild Head Trauma. Part II: Clinical Implications. *Journal of Clinical and Experimental Neuropsychology*, 1997, Vol. 19, 43-57.
- 2 Campbell MJ, Borrie MJ, Spears GF. Risk Factors for Falls in a Community-Based Prospective Study of People 70 Years and Older. *Journal of Gerontology: MEDICAL SCIENCES*, 1989, Vol. 44, No. 4, m112-m117.
- 3 Spar JE, La Rue A, Hewes C, Fairbanks L. Multivariate Prediction of Falls in Elderly Inpatients. *International Journal of Geriatric Psychiatry*, 1987, Vol. 2, 185-188.
- 4 Tinetti ME, Speechley M. Prevention of Falls Among the Elderly. *New England Journal of Medicine*, 1989, Vol. 320, No. 16, 1055-1059.
- 5 The National Committee for Injury Prevention and Control. Injury Prevention: Meeting the Challenge. New York: Oxford University Press; 1989.
- 6 Definition of Risk Factors in Terms of ICD-9-CM Diagnosis Codes
- Infectious and Parasitic Diseases: 001-139
- Neoplasms: 140-239
- Endocrine, Nutritional, and Metabolic Diseases and Immunity Disorders: 240-279
- Mental Disorders: 290-319, excluding 292, 304, 305, 391, 303, 3050 (used to define tranquilizers, alcohol and drugs)
- Alcohol-Related: 297, 304, 305, excluding 3050 (used to define alcohol-related)
- Drug-Related: 304, 9680, 9691-9695
- Tranquillizers: 3054, 9680, 9691-9695
- Diseases of the Nervous System and Sense Organs: 320-389
- Diseases of the Heart and Circulatory System: 390-459, excluding 458 (used to define hypertension)
- Diseases of the Respiratory System: 460-519
- Diseases of the Digestive System: 520-579
- Diseases of the Genitourinary System: 580-629
- Diseases of the Musculoskeletal System and Connective Tissue: 710-739, 7330, excluding 728 (used to define muscle problems)
- Osteoporosis: 7330
- Dizzy: 7804
- Gait Problems: 7812, 7813, 7814, 7817, 7818, 7819
- Muscle Problems, Weakness: 728

**Figure 1**  
**Head Injury Rates per 100,000 Population,  
 by Age Group: Missouri 1995-1997**



**Table 1**

**Odds Ratios and Confidence Intervals for Factors Related to Falls Among Persons 75+: Missouri HSCI 1995-1997**

Disease Factor	Female	85+ Age Group	Gait Problems	Muscle Problems	Osteoporosis	Mental Disorders	Nervous System
Odds Ratio	1.6	1.8	1.9	1.9	2.8	1.3	1.2
Confidence Interval	1.56-1.70	1.70-1.84	1.68-2.24	1.53-2.47	2.59-2.97	1.28-1.41	1.10-1.21

### Provisional Vital Statistics for September 1999

**Live births** decreased slightly in September as 6,960 Missouri babies were born compared with 7,041 in September 1998. The monthly birth rate decreased from 15.8 to 15.4 per 1,000 population. Cumulative births for the 9- and 12-month periods ending with September show increases of 1.4 and 2.9 percent, respectively.

**Deaths** decreased in September, as 3,938 Missourians died compared with 4,144 one year earlier. However for the cumulative 9- and 12-month periods ending with September, deaths increased. For January-September deaths increased 2.7 percent from 40,115 to 41,200.

The **Natural increase** in September was 3,022 (6,960 births minus 3,938 deaths). The rate of natural increase was 6.7 per 1,000 population in September.

**Marriages** increased for all three time periods shown below while **dissolutions of marriage** decreased for all three time periods.

**Infant deaths** increased slightly in September as 53 Missouri babies died compared with 49 in September 1998. Cumulative infant deaths decreased for the 9- and 12-month periods ending with September. For January-September the infant death rate decreased from 8.2 to 7.5 per 1,000 live births.

### PROVISIONAL RESIDENT VITAL STATISTICS FOR THE STATE OF MISSOURI

Item	Number	Rate*	Number	Rate*	12 months ending with September	
					September	Jan.- Sept. cumulative

	<u>1998</u>	<u>1999</u>	<u>1997</u>	<u>1998</u>	<u>1999</u>								
<b>Live Births</b>	7,041	6,960	15.8	15.4	55,988	56,772	13.8	13.8	74,256	76,436	13.6	13.7	14.0
<b>Deaths</b>	4,144	3,938	9.3	8.7	40,115	41,200	9.9	10.0	53,688	54,464	10.1	9.9	10.0
<b>Natural increase</b>													
	2,897	3,022	6.5	6.7	15,873	15,572	3.9	3.8	20,568	21,972	3.5	3.8	4.0
<b>Marriages</b>	4,297	4,327	9.6	9.6	33,672	34,493	0.0	8.4	43,518	44,506	8.2	8.0	8.1
<b>Dissolutions</b>	2,113	1,962	4.7	4.4	19,029	18,570	4.7	4.5	25,562	24,846	4.7	4.7	4.5
<b>Infant deaths</b>	49	53	7.0	7.6	460	428	8.2	7.5	603	565	7.8	8.1	7.4
<b>Population base (in thousands)</b>	...	...	5,439	5,470	...	...	5,439	5,470	...	...	5,397	5,431	5,462

\*Rates for live births, deaths, natural increase, marriages and dissolutions are computed on the number per 1,000 estimated population. The infant death rate is based on the number of infant deaths per 1,000 live births. Rates are adjusted to account for varying lengths of monthly reporting periods.

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